

## Exhibit A SCOPE OF WORK

### TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2	X	ASSESSMENT STUDY
3	X	PROTOTYPE INTEGRATION
4		VALIDATION TESTING
5		TECHNOLOGY TRANSFER ACTIVITIES
6		PRODUCTION READINESS PLAN

### KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	Jim Burns	N/A	N/A
2	Michael Simon	General Atomics, Redhorse	
3	Jim Burns	General Atomics	
4	Leo Holland	General Atomics	
5	Tom Bartley	General Atomics, Redhorse	
6	Michael Simon	General Atomics	

### GLOSSARY

*Specific terms and acronyms used throughout this work statement are defined as follows:*

Acronym	Definition
BAR	Benefits Assessment Report
CPR	Critical Project Review
Energy Commission	California Energy Commission
FESD	Fast Energy Storage Demonstration
GW	gigawatt
MW	Megawatt
MWh	Megawatt hour
PAC	Project Advisory Committee
PIER	Public Interest Energy Research
PRP	Production Readiness Plan

Acronym	Definition
SRD	System Requirements Document
UCC.1	Uniform Commercial Code (Financing Statement)
USRE	Utility-Scale Renewable Energy
VDC	Voltage Direct Current

## Problem Statement

The Grid-Saver™ Fast Energy Storage Demonstration (“Grid-Saver™/FESD”) program addresses the problem of integrating utility-scale renewable energy (USRE) projects into the electric power grid. The proposed solution to this problem is a new, lower cost approach to fast energy that can smooth the variable energy output of renewable energy resources, reduce transmission line needs, increase peak on-line availability of renewable energy, increase system flexibility, and maximize transmission line use. Traditional methods of storing energy for grid power balancing, such as pumped hydroelectric power and keeping natural gas turbines on spinning reserve, have inadequate capacity or response time to meet the future needs imposed by greatly increasing the percentage of grid power supplied by USRE systems. The prevalent form of battery energy storage, phased into use over the past decade, relies on sodium sulfur batteries, which are expensive and present potential safety hazards if the sodium is exposed to water.

The Grid-Saver™ approach is to offer a new solution based on modular building blocks that can be produced at low cost and integrated using advanced systems integration and control methods. The Grid-Saver™/FESD program will demonstrate the viability of this concept by building, testing, and deploying a 5 megawatt (MW) fast energy system comprised of interchangeable lithium battery modules and high-power inverter modules. This modular approach will reduce manufacturing costs and simplify maintenance, while also enabling different size Grid-Saver™ systems to be delivered to meet varying requirements. The challenge is to deliver integrated Grid-Saver™ systems for a cost of less than 50 cents/watt, which is at least 5-6 times lower than the cost of competing sodium sulfur battery systems.

The Grid-Saver™/FESD project contributes to technology improvement and market introduction and penetration in California, primarily by reducing the cost of integrating energy storage systems with renewable energy sources and by doing so with a flexible, scalable solution that is largely manufactured and fully integrated within the State of California. The improved cost, flexibility, and availability can play a significant role in achieving the installation of an additional 4 gigawatt (GW) of grid energy storage capacity in California, the amount of additional energy storage estimated to be required to enable the State to meet its goal of obtaining 33 percent of its energy from eligible renewable sources by 2020.<sup>1</sup>

## Goals of the Agreement

The goals of this Agreement are to:

- Evaluate the feasibility of designing a lower cost fast energy storage system based on innovative design concepts; and

<sup>1</sup> IEPR 2009 Presentation, 2020 Vision, April 2009  
[http://www.energy.ca.gov/2009\\_energy\\_policy/documents/2009-04-02\\_workshop/presentations/1\\_7%20MegaWatt%20Storage%20Farms%20-%20Ed%20Cazalet.pdf](http://www.energy.ca.gov/2009_energy_policy/documents/2009-04-02_workshop/presentations/1_7%20MegaWatt%20Storage%20Farms%20-%20Ed%20Cazalet.pdf)

- Following preliminary validation of these concepts via analysis, proceed to a Prototype Demonstration phase to provide further validation and establish a basis for widespread commercial adoption of such a system.

This project seeks to establish the foundation for widespread commercial adoption of Grid-Saver™ by demonstrating its size, performance, and cost advantages. Construction of the prototype will be preceded by an assessment study to drive out details of the design and validate the feasibility and long term commercial benefits of the Grid-Saver™ design approach. Upon verification of the benefits, the prototype Grid-Saver™ system will be built and tested in a lab setting, paving the way for testing at a USRE site immediately after the conclusion of this project.

### **Objectives of the Agreement**

The objectives of this Agreement are to:

- Perform the analyses and trade studies required to optimize a Grid-Saver™ system designed to meet the above goals:
- Complete a cost-benefit analysis to validate the benefits of specific design concepts such as use of a mass-produced “common battery module” consisting of lower cost lithium cells, operation at higher voltages, and utilization of advanced battery management techniques
- Build a prototype Grid-Saver™ system within tight budgetary constraints, subject to analytical confirmation of substantial cost savings and technical feasibility
- Perform initial testing of the prototype Grid-Saver™ system in a laboratory setting to validate the proof of concept
- Establish a foundation for successful commercialization of the Grid-Saver™ technology through technology transfer activities and production planning

If successful, the Grid-Saver™/FESD project will validate the following benefits:

- Installed cost per watt of peak power delivered at least four times lower than the cost of competing energy storage systems using sodium sulfur batteries;
- Delivery of 5 MW of peak power and approximately 1 megawatt hour (MWh) of total energy in a substantially smaller package than competing grid energy storage technologies;
- Minimum 50% improvement in response time to address system faults;
- Scalability to systems capable of providing tens of megawatts of peak power and/or tens of MWh's of storage capacity.

## **TASK 1.0 ADMINISTRATION**

### **MEETINGS**

#### **Task 1.1 Attend Kick-off Meeting**

The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

**The Contractor shall:**

- Attend a “kick-off” meeting with the California (Energy Commission) Contract Manager, the Contracts Officer, and a representative of the Accounting Office. The Contractor shall bring their Project Manager, Contracts Administrator, Accounting Officer, and others designated by the Energy Commission Contract Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Energy Commission Contract Manager will provide an agenda to all potential meeting participants.

The administrative portion of the meeting shall include, but not be limited to, the following:

- Terms and conditions of the Agreement
- Critical Project Reviews (CPRs) (Task 1.2)
- Match fund documentation (Task 1.7)
- Permit documentation (Task 1.8)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Energy Commission Contract Manager’s expectations for accomplishing tasks described in the Scope of Work;
- An updated Schedule of Deliverables
- Progress Reports (Task 1.4)
- Technical Deliverables (Task 1.5)
- Final Report (Task 1.6)
- Establish the Project Advisory Committee (PAC) (Task 1.10)
- PAC Meetings (Task 1.11)

The Energy Commission Contract Manager shall designate the date and location of this meeting.

**Contractor Deliverables:**

- An Updated Schedule of Deliverables
- An Updated List of Match Funds
- An Updated List of Permits
- Schedule for Recruiting PAC Members

**Energy Commission Contract Manager Deliverables:**

- Final Report Instructions

**Task 1.2 CPR Meetings**

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and if it should, are there any modifications that need to be made to the tasks, deliverables, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Contractor. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Energy Commission Contract Manager and as shown in the Technical Task List above and in the Schedule of Deliverables. However, the Energy Commission Contract Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Contractor.

Participants include the Energy Commission Contract Manager and the Contractor, and may include the Energy Commission Contracts Officer, the Public Interest Energy Research (PIER) Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Energy Commission Contract Manager to provide support to the Energy Commission.

**The Energy Commission Contract Manager shall:**

- Determine the location, date and time of each CPR meeting with the Contractor. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Contractor the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not to modify the tasks, schedule, deliverables and budget for the remainder of the Agreement, including not proceeding with one or more tasks. If the Energy Commission Contract Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration Policy Committee for its concurrence.
- Provide the Contractor with a written determination in accordance with the schedule. The written response may include a requirement for the Contractor to revise one or more deliverable(s) that were included in the CPR.

**The Contractor shall:**

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other deliverables identified in this Scope of Work. Submit these documents to the Energy Commission Contract Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

**Contractor Deliverables:**

- CPR Report(s)
- CPR deliverables identified in the Scope of Work

**Energy Commission Contract Manager Deliverables:**

- Agenda and a List of Expected Participants

- Schedule for Written Determination
- Written Determination

### **Task 1.3 Final Meeting**

The goal of this task is to closeout this Agreement.

#### **The Contractor shall:**

- Meet with the Energy Commission to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

This meeting will be attended by, at a minimum, the Contractor, the Energy Commission Contracts Officer, and the Energy Commission Contract Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Energy Commission Contract Manager.

The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Agreement. The Energy Commission Contract Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Energy Commission Contract Manager and the Contracts Officer about the following Agreement closeout items:

- What to do with any state-owned equipment (Options)
- Need to file UCC.1 form re: Energy Commission's interest in patented technology
- Energy Commission's request for specific "generated" data (not already provided in Agreement deliverables)
- Need to document Contractor's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions, such as repayment provisions and confidential deliverables
- Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement.

#### **Deliverables:**

- Written documentation of meeting agreements and all pertinent information
- Schedule for completing closeout activities

### **REPORTING**

**See Exhibit D, Reports/Deliverables/Records.**

### **Task 1.4 Monthly Progress Reports**

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement.

**The Contractor shall:**

- Prepare progress reports which summarize all Agreement activities conducted by the Contractor for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Energy Commission Contract Manager within 10 working days after the end of the reporting period. Attachment A-2, Progress Report Format, provides the recommended specifications.

**Deliverables:**

- Monthly Progress Reports

**Task 1.5 Test Plans, Technical Reports and Interim Deliverables**

The goal of this task is to set forth the general requirements for submitting test plans, technical reports and other interim deliverables, unless described differently in the Technical Tasks. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Energy Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

**The Contractor shall:**

- Unless otherwise directed in this Scope of Work, submit a draft of each deliverable listed in the Technical Tasks to the Energy Commission Contract Manager for review and comment in accordance with the approved Schedule of Deliverables. The Energy Commission Contract Manager will provide written comments back to the Contractor on the draft deliverable within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Energy Commission Contract Manager. The Energy Commission Contract Manager shall provide written approval of the final deliverable within 5 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

**Task 1.6 Final Report**

The goal of this task is to prepare a comprehensive written Final Report that describes the original purpose, approach, results and conclusions of the work done under this Agreement. The Energy Commission Contract Manager will review and approve the Final Report. The Final Report must be completed on or before the termination date of the Agreement. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Energy Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

The Final Report shall be a public document. If the Contractor has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Contractor shall perform the following subtasks for both the public and confidential versions of the Final Report.

### **Task 1.6.1 Final Report Outline**

#### **The Contractor shall:**

- Prepare a draft outline of the Final Report.
- Submit the draft outline of Final Report to the Energy Commission Contract Manager for review and approval. The Energy Commission Contract Manager will provide written comments back to the Contractor on the draft outline within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final outline to the Energy Commission Contract Manager. The Energy Commission Contract Manager shall provide written approval of the final outline within 5 working days of receipt.

#### **Deliverables:**

- Draft Outline of the Final Report
- Final Outline of the Final Report

### **Task 1.6.2 Final Report**

#### **The Contractor shall:**

- Prepare the draft Final Report for this Agreement in accordance with the approved outline.
- Submit the draft Final Report to the Energy Commission Contract Manager for review and comment. The Energy Commission Contract Manager will provide written comments within 10 working days of receipt.

Once agreement on the draft Final Report has been reached, the Energy Commission Contract Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Energy Commission Contract Manager shall provide written approval to the Contractor within 5 working days.

- Submit one bound copy of the Final Report with the final invoice.

#### **Deliverables:**

- Draft Final Report
- Final Report

## **MATCH FUNDS, PERMITS, AND ELECTRONIC FILE FORMAT**

### **Task 1.7 Identify and Obtain Matching Funds**

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. While the PIER budget for this task will be zero dollars, the Contractor may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds during the term of this Agreement. Match funds must be identified in writing, and the associated commitments obtained before the Contractor can incur any costs for which the Contractor will request reimbursement.

**The Contractor shall:**

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Energy Commission Contract Manager at least 2 working days prior to the kick-off meeting:
  1. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state such in the letter.
  2. If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:
    - A list of the match funds that identifies the:
      - Amount of each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied.
      - Amount of each in-kind contribution, a description, documented market or book value, and its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Contractor shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
    - A copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.
- Discuss match funds and the implications to the Agreement if they are significantly reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide the appropriate information to the Energy Commission Contract Manager if during the course of the Agreement additional match funds are received.
- Notify the Energy Commission Contract Manager within 10 working days if during the course of the Agreement existing match funds are reduced. Reduction in match funds may trigger an additional CPR.

**Deliverables:**

- A letter regarding Match Funds or stating that no Match Funds are provided
- Letter(s) for New Match Funds
- A copy of each Match Fund commitment letter
- Letter that Match Funds were Reduced (if applicable)

**Task 1.8 Identify and Obtain Required Permits**

The goal of this task is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track.

Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement. While the PIER budget for this task will be zero dollars, the Contractor shall show match funds for this task. Permits must be identified in writing and obtained before the Contractor can incur any costs related to the use of the permits for which the Contractor will request reimbursement.

**The Contractor shall:**

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Energy Commission Contract Manager at least 2 working days prior to the kick-off meeting:
  1. If there are no permits required at the start of this Agreement, then state such in the letter.
  2. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
    - A list of the permits that identifies the:
      - Type of permit
      - Name, address and telephone number of the permitting jurisdictions or lead agencies
    - Schedule the Contractor will follow in applying for and obtaining these permits.
- The list of permits and the schedule for obtaining them will be discussed at the kick-off meeting, and a timetable for submitting the updated list, schedule and the copies of the permits will be developed. The implications to the Agreement if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in the progress reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, then provide the appropriate information on each permit and an updated schedule to the Energy Commission Contract Manager.
- As permits are obtained, send a copy of each approved permit to the Energy Commission Contract Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Energy Commission Contract Manager within 5 working days. Either of these events may trigger an additional CPR.

**Deliverables:**

- A letter documenting the Permits or stating that no Permits are required
- Updated list of Permits as they change during the Term of the Agreement
- Updated schedule for acquiring Permits as it changes during the Term of the Agreement
- A copy of each approved Permit

### **Task 1.9 Electronic File Format**

The goal of this task is to unify the formats of electronic data and documents provided to the Energy Commission as contract deliverables. Another goal is to establish the computer platforms, operating systems and software that will be required to review and approve all software deliverables.

#### **The Contractor shall:**

- Deliver documents to the Energy Commission Contract Manager in the following formats:
  - Data sets shall be in Microsoft (MS) Access or MS Excel file format.
  - PC-based text documents shall be in MS Word file format.
  - Documents intended for public distribution shall be in PDF file format, with the native file format provided as well.
  - Project management documents shall be in MS Project file format.
- Request exemptions to the electronic file format in writing at least 90 days before the deliverable is submitted.

#### **Deliverables:**

- A letter requesting exemption from the Electronic File Format (if applicable)

### **PAC**

#### **Task 1.10 Establish the PAC**

The goal of this task is to create an advisory committee for this Agreement.

The PAC should be composed of diverse professionals. The number can vary depending on potential interest and time availability. The Contractor's Project Manager and the Energy Commission Contract Manager shall act as co-chairs of the PAC. The exact composition of the PAC may change as the need warrants. PAC members serve at the discretion of the Energy Commission Contract Manager.

The PAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter
- Members of the trades who will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives)
- Public Interest Market Transformation Implementers
- Product Developers relevant to project subject matter
- U.S. Department of Energy Research Manager
- Public Interest Environmental Groups
- Utility Representatives
- Members of the relevant technical society committees

The purpose of the PAC is to:

- Provide guidance in research direction. The guidance may include scope of research; research methodologies; timing; coordination with other research. The guidance may be based on:
  - technical area expertise
  - knowledge of market applications
  - linkages between the agreement work and other past, present or future research (both public and private sectors) they are aware of in a particular area.
- Review deliverables. Provide specific suggestions and recommendations for needed adjustments, refinements, or enhancement of the deliverables.
- Evaluate tangible benefits to California of this research and provide recommendations, as needed, to enhance tangible benefits.
- Provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

**The Contractor shall:**

- Prepare a draft list of potential PAC members that includes name, company, physical and electronic address, and phone number and submit it to the Energy Commission Contract Manager at least 2 working days prior to the kick-off meeting. This list will be discussed at the kick-off meeting and a schedule for recruiting members and holding the first PAC meeting will be developed.
- Recruit PAC members and ensure that each individual understands the member obligations described above, as well as the meeting schedule outlined in Task 1.11.
- Prepare the final list of PAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each PAC member.

**Deliverables:**

- Draft List of PAC Members
- Final List of PAC Members
- Letters of acceptance, or other comparable documentation of commitment for each PAC Member

**Task 1.11 Conduct PAC Meetings**

The goal of this task is for the PAC to provide strategic guidance to this project by participating in regular meetings or teleconferences.

**The Contractor shall:**

- Discuss the PAC meeting schedule at the kick-off meeting. The number of face-to-face meetings and teleconferences and the location of PAC meetings shall be determined in consultation with the Energy Commission Contract Manager. This draft schedule shall be presented to the PAC members during recruiting and finalized at the first PAC meeting.

- Organize and lead PAC meetings in accordance with the schedule. Changes to the schedule must be pre-approved in writing by the Energy Commission Contract Manager.
- Prepare PAC meeting agenda(s) with back-up materials for agenda items.
- Prepare PAC meeting summaries, including recommended resolution of major PAC issues.

**Deliverables:**

- Draft PAC Meeting Schedule
- Final PAC Meeting Schedule
- PAC Meeting Agenda(s) with Back-up Materials for Agenda Items
- Written PAC meeting summaries, including recommended resolution of major PAC issues

**TECHNICAL TASKS**

The Contractor shall prepare all deliverables in accordance with the requirements in Task 1.5. Deliverables not requiring a draft version are indicated by marking “(no draft)” after the deliverable name.

**Task 2 ASSESSMENT STUDY**

The goal of this task is to assess the benefits of the Grid-Saver™ system and validate its worthiness to proceed to the full demonstration phase. Results will be presented to the PAC for review and comment before presentation to the Energy Commission. A CPR will be held at the conclusion of this task and the project will proceed beyond this task only if it demonstrates satisfactory progress.

**The Contractor shall:**

- Engage stakeholders and assemble a broad draft list of system requirements
- Perform a system requirements analysis to identify and narrow the list of requirements Grid-Saver™ must meet. This analysis shall focus on requirements for renewable energy integration into the grid but will also consider other potential applications such as bridging capacity gaps in distribution and in combustion turbine peaker generation. Specific requirements shall include but not be limited to
  - Operating voltage, including consideration of voltages ranging from 640 to 6,400 Volts direct current (VDC)
  - Peak power output
  - Power ramp rate
  - Total deliverable energy capacity
  - Modularity/portability
  - Maintenance intervals
  - Battery thermal requirements
  - Safety
  - Site and installation issues
  - Communication and data transfer requirements

- Prepare a report documenting the system requirements
- Define candidate Grid-Saver™ system architectures compatible with system requirements and gather component data
- Formulate engineered system metrics list for concept validation
- Validate candidate functionality using model-based power systems rapid prototyping methods to predict performance when integrated with existing models of renewable on-grid behavior
- Perform technology readiness and risk assessment of validated candidate architectures
- Rank and select top candidate system architectures for refinement
- Refine system candidates in accordance with functionality, readiness and risk assessment. The final candidate architectures shall be of sufficient maturity to enable generation of a complete bill of material and final cost estimates.
- Create refined candidate cost estimates. These shall include but not be limited to:
  - Acquisition costs of all major components (batteries, inverters, etc.), both for prototype unit and projections of higher volume costs
  - Labor hours and costs to assemble prototype unit and subsequent units
  - Labor hours and costs for testing and validation of prototype unit
  - Estimates of costs for installation and maintenance at renewable energy sites
- Perform a cost-benefits analysis to compare Grid-Saver™ costs and expected benefits. Benefits to be considered shall include but not be limited to:
  - Impact on acceptance of new renewable energy sources
  - Impact on total cost of installed renewable energy capacity
  - Improved power quality for power supplied by renewable sources
  - Ability to make up for brief power interruptions at renewable energy sources
  - Frequency regulation
  - Reduction in requirements to maintain spinning reserves and associated benefits in terms of increasing electricity availability and reducing electricity cost
  - Improvements in grid stability/reliability
  - Reduced carbon and other emissions from more efficient use of natural gas turbines and increased use of renewable energy
  - Economic benefits of manufacturing Grid-Saver™ in California
- Prepare a “Benefits Assessment Report” (BAR) and slide presentation documenting results of the cost-benefits analysis and recommendations for final system architecture. Present results to the PAC and incorporate its feedback.
- Participate in CPR #1 as per Task 1.2 to review results of the assessment study and reach a go/no-go decision regarding proceeding to the demonstration phase.

**Deliverables:**

- System Requirements Report (no draft)

- Benefits Assessment Report (no draft)
- Benefits Assessment Review Presentation (no draft)
- CPR #1 Report

### **Task 3 PROTOTYPE INTEGRATION**

The goal of this task is to build the prototype Grid-Saver™ system, upon successful completion of CPR #1 and mutual agreement to proceed to the demonstration phase.

#### **The Contractor shall:**

- Create detailed mechanical, electrical and controls interface specifications and complete selection design and built detail design of hardware components
- Finalize the bill of materials and review cost and availability
- Order and acquire all major components required for assembly of the prototype Grid-Saver™ unit. These will include:
  - Standard battery modules
  - Battery management system
  - Battery storage racks/enclosures/structures
  - Inverter modules
  - Central controller/processor
  - Communications hardware
  - Isolation/safety systems
- Order and acquire all other piece parts and materials required for assembly of the prototype Grid-Saver™ unit, to include but not be limited to:
  - Wire and cable
  - Mounting brackets
  - Cooling ducts and fans
- Develop and provide report on Grid-Saver™ assembly procedures and documentation
- Assemble prototype Grid-Saver™ unit
- Provide photographs of Grid-Saver™ assembly progress
- Generate a Prototype Integration Report that includes the description and analysis of work performed under this task
- Participate in CPR #2 as per task 1.2

#### **Deliverables:**

- Grid-Saver™ Assembly Procedures and Documentation Report (no draft)
- Photographs of Grid-Saver™ (no draft)
- Prototype Integration Report
- CPR #2 Report

#### **Task 4 VALIDATION TESTING**

The goal of this task is to perform comprehensive tests on the prototype Grid-Saver™ system to validate its basic performance characteristics.

##### **The Contractor shall:**

- Develop Grid-Saver™ test and operational safety procedures and documentation
- Generate a Validation Testing Plan
- Transport the prototype Grid-Saver™ unit to a test cell at General Atomics. The test cell shall provide:
  - Power outlets capable of supplying 5 MW of power
  - Test load rated at up to 5 MW
- Perform validation tests on the prototype Grid-Saver™ unit, including validation of:
  - System power output
  - Energy storage capacity
  - System reliability
- Prepare a System Test Report for all activities in this task.
- Analyze and justify that the results from this result can be directly applied to an Utility Scale plant with a name-plate rating equal to or in excess of 10 MW
- Discuss test results with the PAC and respond to its suggestions as appropriate
- Generate a Grid-Saver System Benefit Verification Report

##### **Deliverables:**

- Validation Testing Plan
- System Test Report
- Grid-Saver System Benefit Verification Report (no draft)

#### **Task 5 TECHNOLOGY TRANSFER ACTIVITIES**

The goal of this task is to develop a plan to make the knowledge gained, experimental results and lessons learned available to key decision-makers.

##### **The Contractor shall:**

- Prepare a Technology Transfer Plan. The plan shall explain how the knowledge gained in this project will be made available to the public. The level of detail expected is least for research-related projects and highest for demonstration projects. Key elements from this report shall be included in the Final Report for this project.
- Conduct technology transfer activities in accordance with the Technology Transfer Plan. These activities shall be reported in the Monthly Progress Reports.
- Utilize the PAC as appropriate to expedite technology transfer.
- Indicate the intended use and users of the project results.

**Deliverables:**

- Technology Transfer Plan

**Task 6 PRODUCTION READINESS PLAN**

The goal of the plan is to determine the steps that will lead to the manufacturing of the technologies developed in this project or to the commercialization of the project's results.

**The Contractor shall:**

- Prepare a Production Readiness Plan (PRP). The degree of detail in the PRP discussion should be proportional to the complexity of producing or commercializing the proposed product and its state of development. The plan shall include, as appropriate, but not be limited to:
  - Identification of critical production processes, equipment, facilities, personnel resources, and support systems that will be needed to produce a commercially viable product;
  - Internal manufacturing facilities, as well as supplier technologies, capacity constraints imposed by the design under consideration, identification of design critical elements and the use of hazardous or non-recyclable materials. The product manufacturing effort may include "proof of production processes;"
  - A projected "should cost" for the product when in production;
  - The expected investment threshold to launch the commercial product;
  - An implementation plan to ramp up to full production.

**Deliverables:**

- Production Readiness Plan